

1 **CLAIMS:**

2
3 Having thus described the invention, what we claim as
4 new and desire to secure by Letters Patent is as
5 follows:
6

7 1. A semiconductor die comprising:

8 a planar semiconductor member; and
9 a plurality of conductive pins extending from said
10 semiconductor member in a direction parallel to a plane
11 of said semiconductor member.
12

13 2. The semiconductor die of claim 1, wherein said pins
14 extend directly from said semiconductor member.
15

16 3. The semiconductor die of claim 1, wherein said
17 semiconductor has a plurality of sides, and wherein
18 said pins extend from at least one of said sides.
19

20 4. The semiconductor die of claim 1, wherein said
21 semiconductor has a plurality of sides, and wherein
22 said pins extend from all of said sides.
23

24 5. The semiconductor die of claim 1, wherein said pins
25 are micro-pins having a of length of 1 to 1000 microns,
26 a width of 1 to 500 microns and a depth of 1 to 800
27 microns in the direction into the die 20.
28

29 6. The semiconductor die of claim 1, wherein said
30 semiconductor has a plurality of sides, and wherein

1 said pins extend along said sides in a direction
2 perpendicular to a plane of said semiconductor member.

3

4 7. The semiconductor die of claim 6, in combination
5 with at least one additional semiconductor die, said
6 semiconductor dies being disposed one over another so
7 that respective pins of said semiconductor die are
8 stacked one over to facilitate electrical contact with
9 one another.

10

11 8. The combination of claim 7, wherein said respective
12 pins are diffusion bonded to one another to provide
13 said electrical contact.

14

15 9. The combination of claim 7, further comprising an
16 electrically conductive material disposed between said
17 respective pins so as to provide said electrical
18 contact.

19

20 10. The combination of claim 7, further comprising a
21 substrate on which said combination is mounted.

22

23 11. The combination of claim 10, wherein said substrate
24 is formed of a semiconductor material.

25

26 12. The combination of claim 10, further comprising a
27 second substrate, said second substrate being formed of
28 an insulating material.

29

1 13. The semiconductor die of claim 1, in combination
2 with at least one other semiconductor die of claim 1,
3 successive ones of said semiconductor dies being
4 assembled with at least one wiring substrate between
5 dies, said at least one wiring substrate providing
6 electrical connections between said dies.

7
8 14. The combination of claim 13, wherein said dies and
9 said at least one substrate are assembled so as to form
10 a solid rectangle.

11
12 15. The combination of claim 14, further comprising at
13 least one additional semiconductor die assembled to the
14 outside of said solid rectangle, said additional
15 semiconductor die having electrical connections to at
16 least one of said dies in said solid rectangle.

17
18 16. The combination of claim 13, wherein said wiring
19 substrates have opening therein to facilitate
20 management of heat.

21
22
23 17. A semiconductor die comprising:
24 a planar semiconductor member; and
25 a plurality of first electrically conductive pins
26 formed on a surface of said semiconductor member, said
27 pins having portions extending along a side of said
28 semiconductor member.

29

1 18. The semiconductor member of claim 17, in
2 combination with:

3 a second semiconductor member having second
4 electrically conductive pins formed on a surface of
5 said second semiconductor member, said second pins
6 having portions extending along a side of said second
7 semiconductor member, at least a portion of said first
8 pins and said second pins being disposed on said
9 semiconductor members so as to align with one another
10 when said semiconductor members are placed in close
11 proximity to one another, so that electrical contact
12 between respective ones of said first pins and said
13 second pins is facilitated.

14
15 19. The combination of claim 18, further comprising at
16 least one additional semiconductor member, said
17 additional semiconductor member having additional pins,
18 said additional pins having portions extending along a
19 side of said additional semiconductor member, said
20 additional pins being disposed on said additional
21 semiconductor member so as to align with additional
22 pins on an additional side of said first semiconductor
23 member or said second semiconductor member when said
24 additional semiconductor member is placed in close
25 proximity to said first semiconductor member or said
26 second semiconductor, so that electrical contact
27 between respective ones of said additional pins and
28 said first pins or second pins is facilitated.

29

1 20. The combination of claim 19, wherein said
2 semiconductor members are disposed so as to be
3 coplanar.
4

5
6 21. A semiconductor die substrate comprising:

7 a planar semiconductor member, said member having
8 a plurality of micro-cups formed on a surface thereof,
9 at least a portion of said micro-cups being sized,
10 shaped and positioned so as to receive micro-pins.
11

12 22. The semiconductor die of claim 21, in combination
13 with:

14 a second semiconductor die, said second
15 semiconductor die comprising:

16 a planar semiconductor member;

17 a plurality of conductive micro-pins
18 extending from said semiconductor member in a direction
19 parallel to a plane of said semiconductor member,

20 said micro-pins being received in said micro-cups.
21

22 23. The combination of claim 22, wherein said
23 semiconductor die substrate and said second
24 semiconductor die are perpendicular to one another.
25

26 24. The combination of claim 22, further comprising at
27 least one bracket member, said bracket member having a
28 first surface in contact with said semiconductor die
29 substrate and a second surface in contact with said
30 second semiconductor die.

1 25. The combination of claim 22, further comprising an
2 adhesive material disposed between said semiconductor
3 members to facilitate said semiconductor members being
4 secured to one another.

5
6 26. A method for forming a semiconductor die,
7 comprising:

8 forming a trench in a surface of said die;
9 filing the trench with a sacrificial material;
10 patterning said die to form a series of channels
11 extending substantially perpendicularly to said trench;
12 depositing a conductive material in said channels;
13 removing at least a portion of the sacrificial
14 material; and

15 removing portions of said die under said trench so
16 as to separate a portion of said die on one side of
17 said trench from a portion on another side of said
18 trench.

19
20 27. The method of claim 26, further comprising:

21 patterning said sacrificial material so that said
22 channels extend so as to be partially in a portion of
23 said die and partially a portion of said sacrificial
24 material.

25
26 28. The method of claim 26, wherein said sacrificial
27 material is patterned to a depth greater than said die.

28
29 29. The method of claim 26, wherein said removing is
30 performed by grinding or etching of said die.

1

2 30. The method of claim 26, wherein said die is part
3 of a wafer having a plurality of dies, and said trench
4 is a dicing lane of said wafer.

5

6 31. The method of claim 26, wherein said sacrificial
7 material is a polymer.

8

9 32. The method of claim 26, wherein said sacrificial
10 material is a photoresist.

11

12 33. The method of claim 26, wherein said conductive
13 material is one of a metal, a conductive paste, and a
14 solder.

15

16 34. The method of claim 26, further comprising
17 depositing an adhesion layer in said channels prior to
18 depositing said conductive material.

19

20 35. The method of claim 34, wherein said adhesion
21 layer is formed of a polymer and a silicon oxide.

22

23 36. A method for forming a semiconductor die,
24 comprising:

25

forming a trench in a surface of said die;

26

filing the trench with a sacrificial material;

27

patterning said die to form a series of channels

28

extending substantially perpendicularly to said trench;

29

depositing a conductive material in said channels;

1 removing portions of said die under said trench;
2 and
3 removing at least a portion of the sacrificial
4 material so as to separate a portion of said die on one
5 side of said trench from a portion on another side of
6 said trench.

7
8 37. A method of forming substrates with at least one
9 micro-cup, comprising:
10 forming at least one via in the substrate;
11 coating said at least one via with a conductive
12 material or a conductive and adhesive material to form
13 said micro-cup; and
14 coating adhesive material on the substrate to
15 facilitate attachment of a device having at least one
16 pin, said at least one pin being sized, shaped and
17 positioned to be received in a respective one of said
18 at least one via.

19
20 38. The method of claim 37, further comprising
21 assembling said device to said substrate.